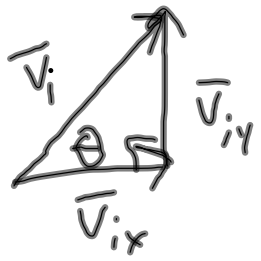
# Projectile Motion:

- Motion of an object in flight in 2-dimensions

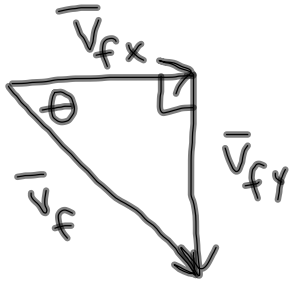
- Assumptions:
  1) Ignore air resistance
  2) Free-fall in y-direction (only force is gravity)
  3) No forces in x-direction

- Variables:
  - x-direction:
    $\Delta\bar{x}, \bar{v}_{ix}, \bar{v}_{fx}, a_x (= 0\ m/s^2)$
  - y-direction:
    $\Delta\bar{y}, \bar{v}_{iy}, \bar{v}_{fy}, a_g (= 9.8\ m/s^2$ down)
  - both directions:
    $t, \bar{v}_i, \theta_i, \bar{v}_f, \theta_f$

Triangles we can draw:




initial velocity




final velocity

## Equations:

$$\Delta x = v_{ix}t + \frac{1}{2}a_x t^2 \quad \Delta x = v_{ix}t$$

$$v_{fx} = v_{ix} + a_x t \quad v_{fx} = v_{ix}$$

$$v_{fx}^2 = v_{ix}^2 + 2a_x\Delta x \quad v_{fx}^2 = v_{ix}^2$$

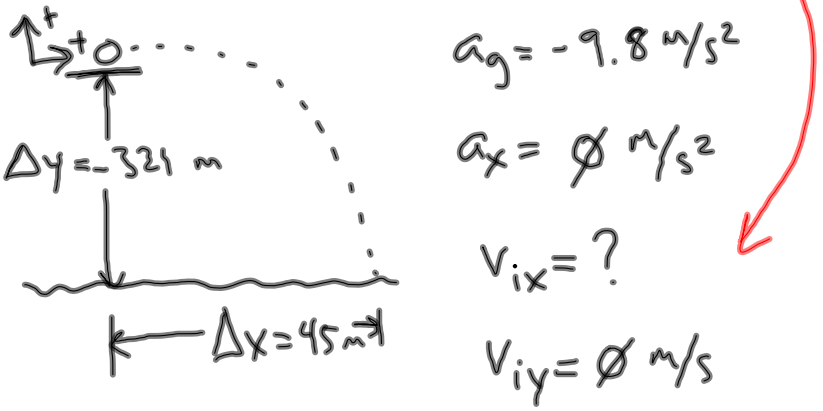
$$\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$$

$$v_{fy} = v_{iy} + a_g t$$

$$v_{fy}^2 = v_{iy}^2 + 2a_g\Delta y$$

## Projectile Motion Notes and Practice Problem 2.16.12 Honors Physics

The Royal Gorge Bridge in Colorado rises 321 m above the Arkansas River. Suppose you kick a rock horizontally off the bridge. The magnitude of the rock's horizontal displacement is 45.0 m. Find the speed at which the rock was kicked.




find time first from y-direction:

$$\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

$$= \sqrt{\frac{2(-321\ m)}{(-9.8\ m/s^2)}}$$

$$= 8.09\ s$$

Find $v_{ix}$ from x-direction:

$$\Delta x = v_{ix}t$$

$$v_{ix} = \frac{\Delta x}{t}$$

$$= \frac{45\ m}{8.09\ s}$$

$$= 5.56\ m/s$$